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HABITAT MANAGEMENT SERIES FOR UNIQUE OR ENDANGERED SPECIES

by Mark Zarn, Biologist
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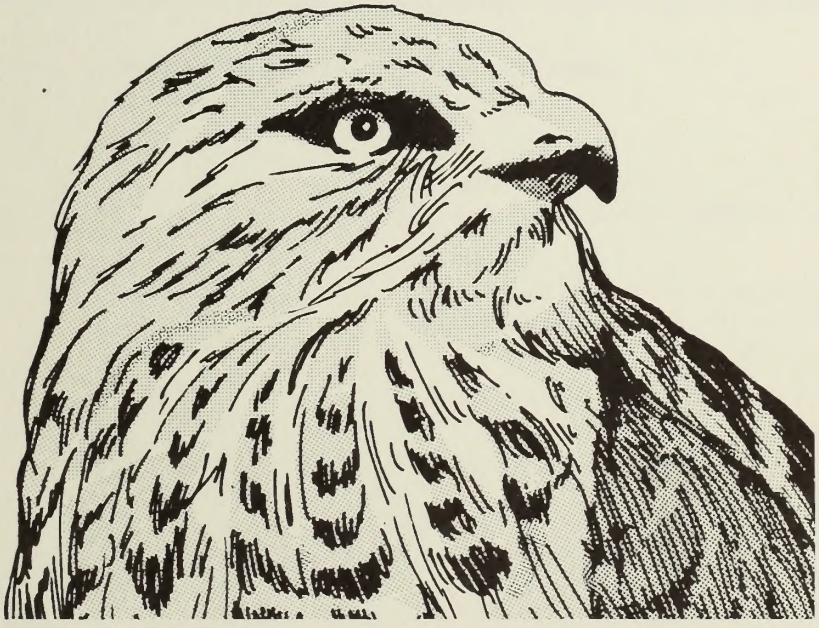
Report No. 14

Rough-legged Hawk
(Buteo lagopus sanctijohannis)



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FOREWORD

This Technical Note series on wildlife is designed to provide a literature review and summary of current knowledge pertaining to endangered and other wildlife species occurring on public lands. We in the Bureau of Land Management have recognized the need for basic wildlife information in order to do an effective job in land-use planning. Sound planning must identify the negative aspects as well as the positive benefits of any proposed land management decision or program. It is our hope, too, that this series will also prove useful to others--be they land managers, students, researchers or interested citizens.

Curt Berklund

Director
Bureau of Land Management
Department of the Interior

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1. Species Description

The rough-legged hawk, Buteo lagopus, is the most common hawk of the American arctic. Authorities recognize several subspecies, but only Buteo lagopus sanctijohannis occurs in North America (see figure 1).

Rough-legged hawks exhibit the reversed size dimorphism characteristic of falconiforms. Cade (1955) gave the average weight of four adult males from the Colville River, Alaska, as 915 (883 - 943) grams. Four adult females from the same region averaged 1216 (1033 - 1400) grams. Wing length in five adult males averaged 401 (392 - 410) mm; female wing length averaged 426 (400 - 445) mm (Brown and Amadon, 1968).

Adult rough-legs display extreme plumage variation. Many writers attribute this to dimorphism or to polymorphism and assign specimens either to a "light phase" or to a "dark (melanistic) phase." Instead of being truly polymorphic, the species exhibits a wide range of continuous gradation in plumage color. Color varies from a nearly uniform dark plumage to light brown with only scattered darker markings on a nearly white ventral surface, and wide whitish edges on individual dorsal feathers (Cade, 1955).

Generally, dorsal coloration in adults consists of irregular markings of white, grayish, dusky, rust, brown, or black. The whitish head and neck are streaked with dark. Ventral surfaces range from white to buffy, streaked and spotted with dark brown or brownish-black, and these darker markings sometimes coalesce at the abdomen to form a broad patch which may be interrupted medially. Long, coarse feathers completely clothe the tarsi; generally light in color, they are barred or spotted with darker hues. The long tail, white at its base, shows broad subterminal dark bands and a whitish tip. The underside of the wings normally is light in color, bordered by the dark tips of the primaries and with a dark patch at the base of each wing formed by dark coverts (see figure 2). The iris is light brown, the bill and claws bluish-black, the cere greenish-yellow, and the feet dull yellow (Brown and Amadon, 1968; Cade, 1955; Gabrielson and Lincoln, 1959; Bent, 1937; Friedman, 1950). Adults experience a single annual molt between June and October. Females molt earlier than males. Perhaps this is an adaptive mechanism which allows males greater predation efficiency while females carry out incubation. Later in the nesting season, when food demands by nestlings increase and food supplies around the nest decrease, the female can join the male in hunting and increase the supply of food to the nest (Cade, 1955).

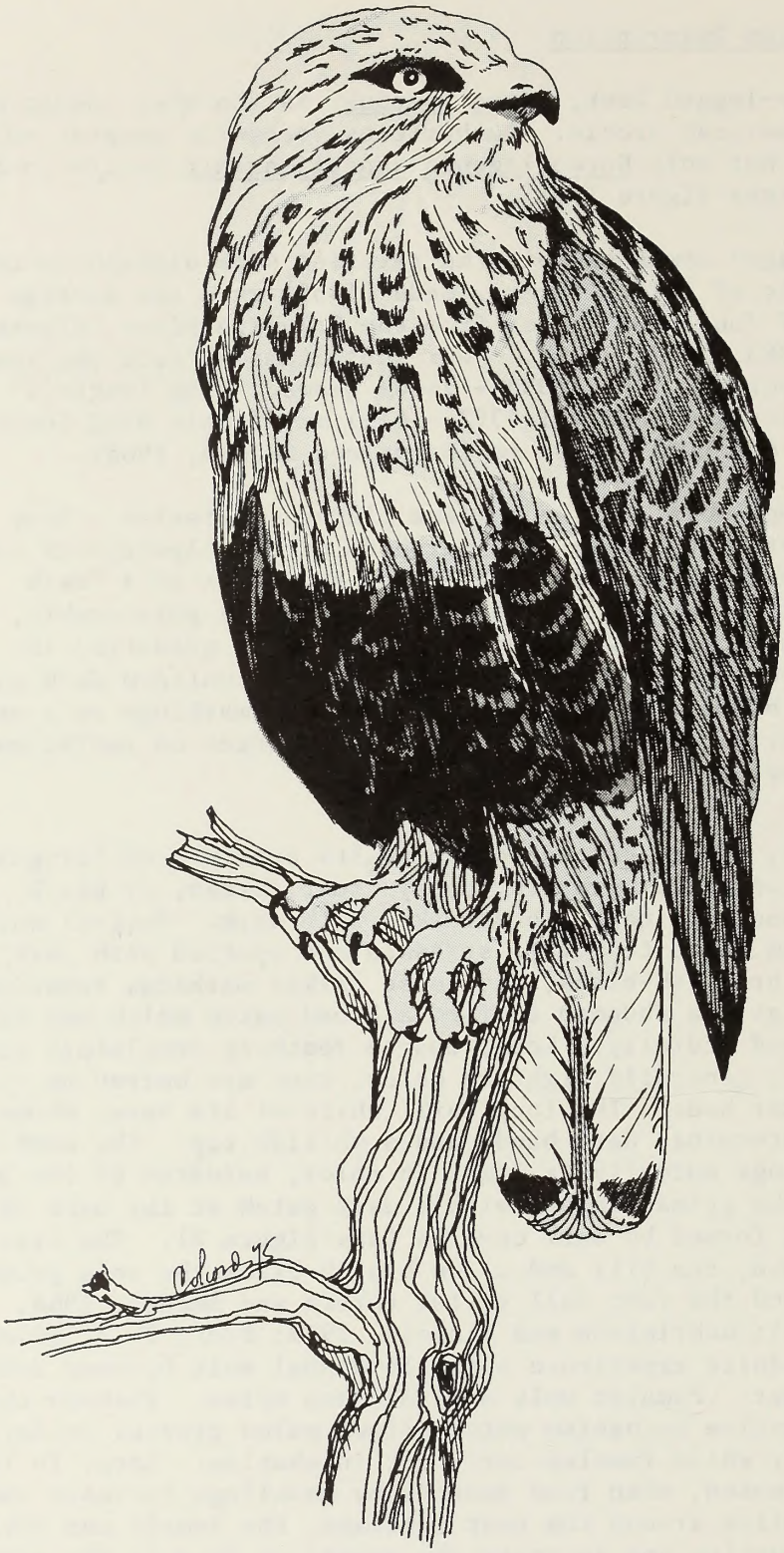

Figure 1: Rough-legged Hawk

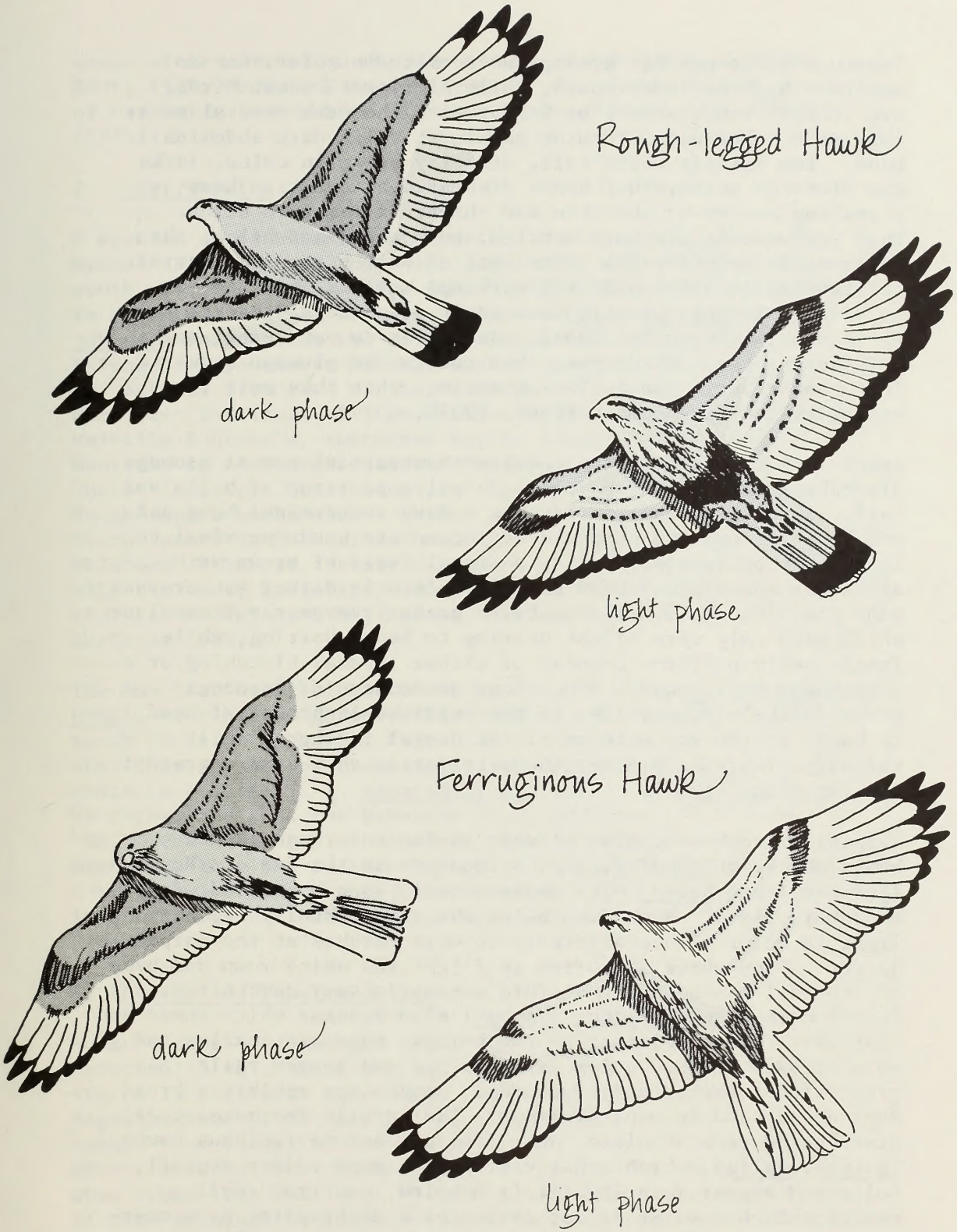

Figure 2: Flight silhouettes

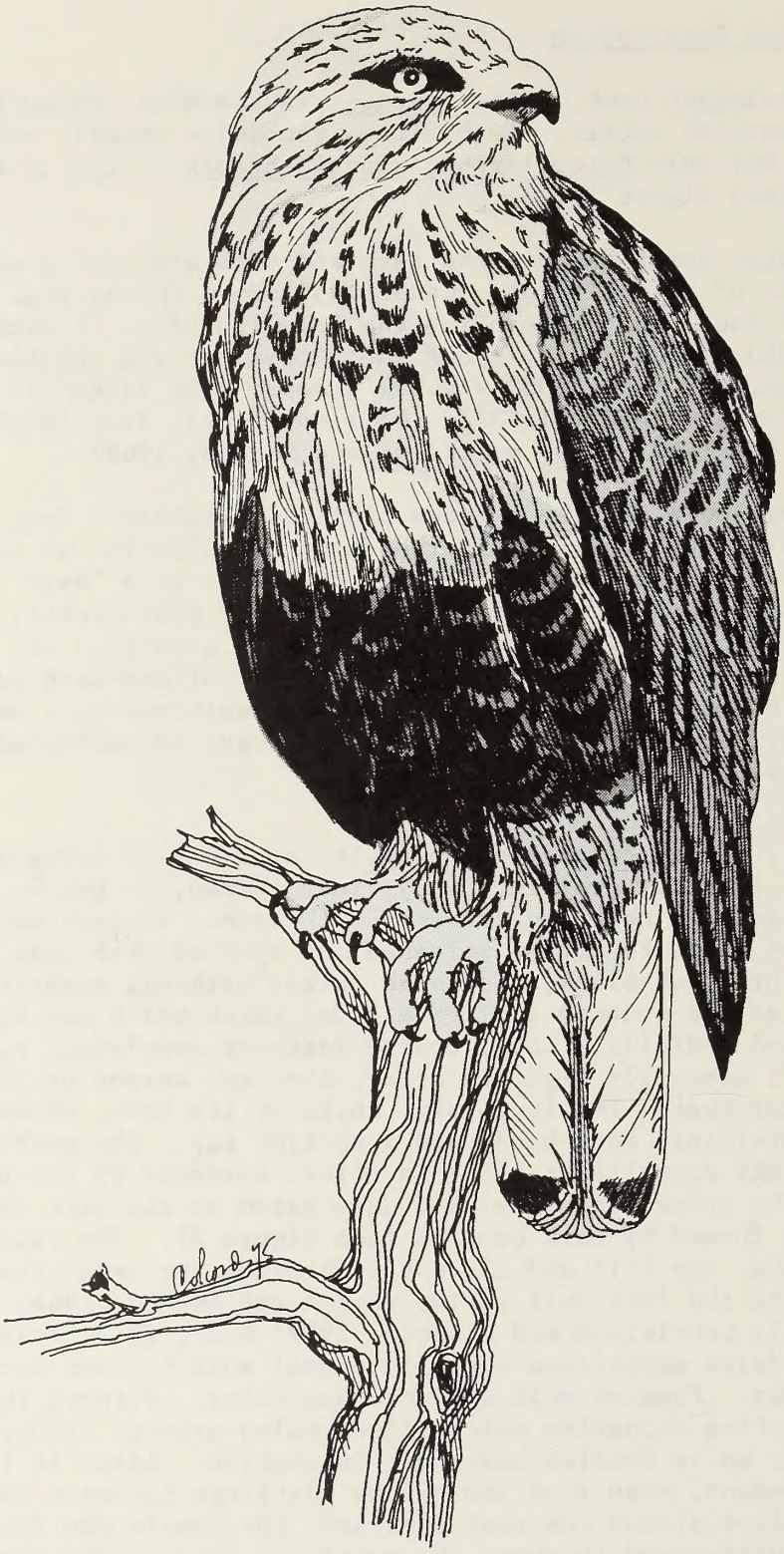

Figure 1: Rough-legged Hawk

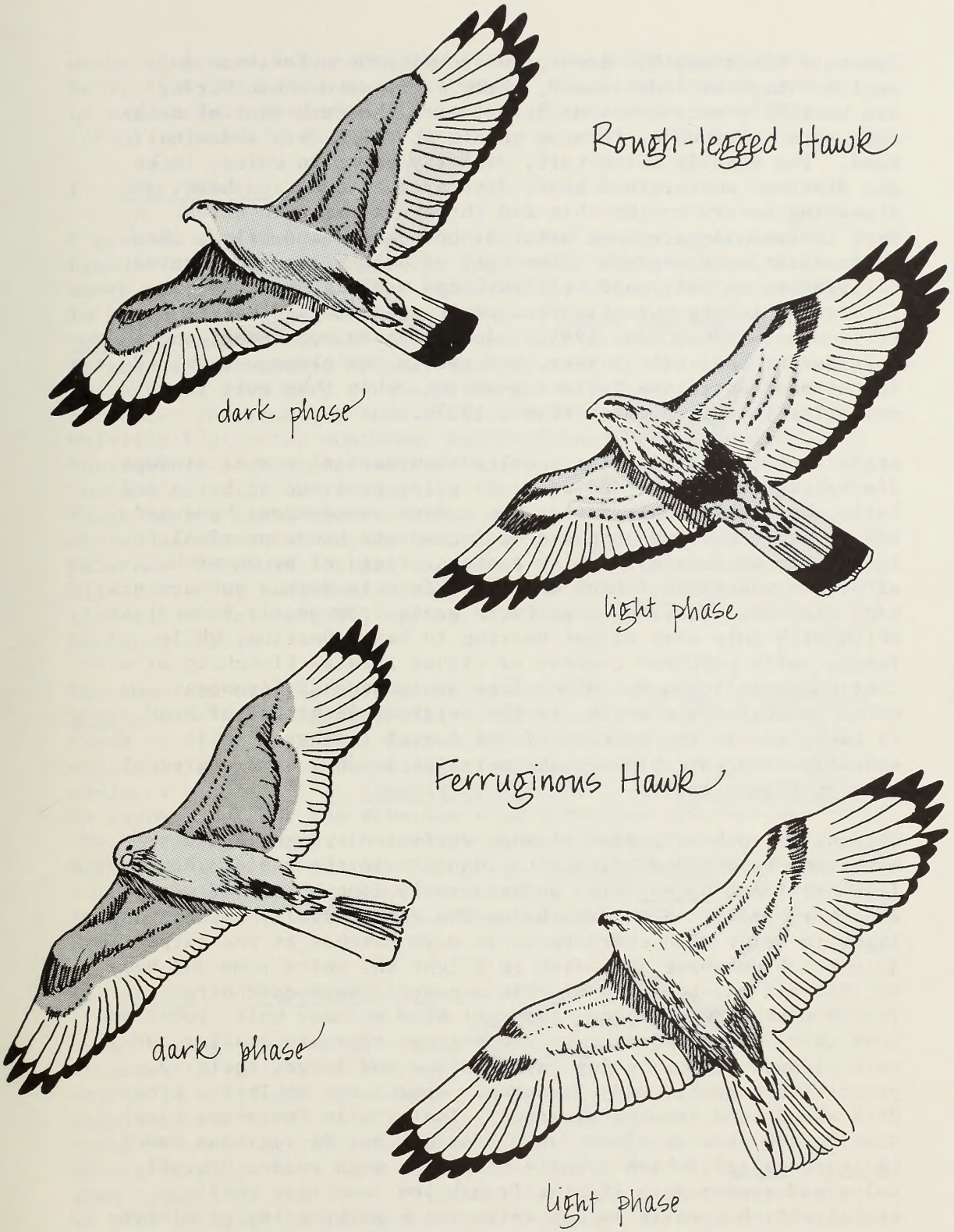

Figure 2: Flight silhouettes

Immature birds exhibit greater uniformity in color than do adults. Lighter individuals, while similar to adult birds, are ventrally more tawny or buffy, with the dark ventral markings more continuous, forming an almost solid dark abdominal band. The basally white tail, distally brown in color, lacks the distinct subterminal bands displayed by adults. Less streaking occurs on the chin and throat in immature birds. Dark individuals are more mottled, both above and below, than their adult counterparts. The tail of dark birds is unbarred. Differences in belly and tail markings may aid the observer in distinguishing juvenile from adult rough-legged hawks (Friedmann, 1950; Cade, 1955). Juveniles do not experience a molt during their first year, but retain the plumage acquired in the nest until the following spring, when they molt into essentially adult plumage (Cade, 1955).

Aside from size dimorphism, adults show partial sexual plumage dimorphism as well, principally in color patterns of belly and tail. Generally, male tails show a dark subterminal band and one to three or more complete or incomplete bands proximal to it. Tails of females display a distal field of brown with either no subterminal band or only a faintly darker subterminal band visible. Male belly patterns grade from nearly immaculate white with only very slight barring to heavy barring, while female belly patterns consist of either lateral blotching or a continuous belly band. Other less pronounced differences occur on the wing coverts, in the relative lightness of head to back, and in the pattern of the dorsal feathers. All sexually dimorphic plumage characteristics show some degree of overlap (Cade, 1955).

Because of such extensive plumage variation, rough-legged hawks may be quite difficult to identify in the field. Rough-legs are large Buteos with comparatively long but broad wings and short tails. Seen from below the wings usually appear light in color with characteristic dark patches at the carpal joints. From above and often in flight the white rump and base of the tail may be quite visible except in very dark birds. Though marsh hawks (Circus cyaneus) also possess white rumps and hunt in a fashion similar to rough-legs, they are smaller and more slender birds, having narrow wings and longer tails in proportion to other body features. Rough-legs exhibit a broad dark chest band in many plumages. Their fully feathered tarsi distinguish them at close range from all but ferruginous hawks (Buteo regalis), which usually display a much redder overall color and appear much lighter from below, and from small eagles, which usually do not share the same breeding or wintering areas (see figure 2). Rough-legged hawks typically hover while searching for prey. Their basically unsuspicious nature often allows a close approach, especially within the first few

weeks after arrival on the wintering grounds (Belknap, 1966; Bent, 1937; Brown and Amadon, 1968). For a detailed treatment of variation in North American rough-legged hawks, see Cade (1955).

2. Distribution

A species of panboreal distribution, the rough-legged hawk breeds in the tundra and taiga regions of the world and winters south of its breeding range (Cade, 1955; White and Cade, 1971). In North America the breeding range of Buteo lagopus sanctijohannis encompasses the extreme eastern end of the Aleutian Islands and southwest Alaska, much of coastal and arctic Alaska, and extends from east of the MacKenzie River across northern Northwest Territory, Prince Patrick Island, Victoria Island, Melville Peninsula, southwest Baffin Island, and northern Manitoba to northern Labrador, Newfoundland and southeast Quebec (American Ornithologists' Union, 1957; Cade, 1955). Rough-legged hawks winter across southern Canada and the United States south to California, southern Arizona, New Mexico, Oklahoma, Missouri, rarely Tennessee and Virginia, and occasionally to Texas, Louisiana, Georgia and Florida (American Ornithologists' Union, 1957; Sprunt, 1940, 1941; Herbert and Skelton, 1953).

The American Ornithologists' Union also includes B. l. kamschatkensis as a breeding subspecies inhabiting northwest Alaska south to Saint Michael. Cade (1955), however, has determined that this segment of the Alaskan population consists of intermediates between B. l. sanctijohannis and B. l. kamschatkensis. He recommends that the Siberian form should be deleted from the North American list since no proof exists of its occurrence here, and that the designation B. l. sanctijohannis be reserved for North American populations breeding on the Aleutian Islands, in southwestern Alaska, and in Canada east of the MacKenzie River.

3. Status and Population Trend

Because rough-leg numbers and productivity fluctuate greatly in response to variations in prey density, the species' current status is difficult to assess. On a study area along the Sagavinirktok River, Alaska, active rough-leg nests varied in number from six in 1970 to twenty in 1972 to twelve in 1974, in direct response to rodent population densities. Even in years when rough-legs lay large clutches, they may desert their eggs if prey populations crash during the incubation period (Clayton White, personal communication).

Figure 3: Distribution of Rough-legged Hawk in North America (from Brown & Amadon, 1968)

The rough-leg breeding population also fluctuated greatly between 1968 and 1972 on a 5700-square-kilometer area of the Seward Peninsula, Alaska. The number of breeding pairs grew from 35 in 1968 to 43 pairs in 1969 and a high of 82 pairs in 1970. But in 1971 the number of nesting pairs plummeted to only 10, and only two young reached fledging age from these 10 nesting attempts. Severe weather in the fall of 1970 and the spring of 1971 held microtine populations to very low levels, and rough-legs which otherwise might have nested either went elsewhere to nest or did not attempt to nest at all that year. Active nests were clumped in several small groups through the study area, suggesting that isolated rodent populations survived the winter in numbers adequate to support the nesting activities of a small number of hawks. The rough-leg breeding population recovered substantially the next year, 1972, reaching 44 nesting pairs (Swartz, Walker, Roseneau and Springer, 1975; Alan Springer, personal communication).

While presently natural constraints, such as food availability, are the major factors governing rough-leg numbers, a new potential threat to the species lies in man's development of Alaska's natural resources (Springer, personal communication). In their study of raptor populations along the Colville River, Alaska, White and Cade (1971) concluded that rough-legged hawks should hold their own as a breeding population except where drilling sites, radio stations, roads, pipelines and other installations destroy nesting habitat.

4. Life History

Rough-legged hawks exhibit distinct diurnal activity patterns even in summer above the Arctic Circle, where the sun remains above the horizon for long periods. On a study area in Finland, rough-legs left their nests between 4 a.m. and 5 a.m. in June and July, and returned to the nest with the first prey item about an hour later. Hunting activity continued throughout the day, generally ceasing between 8 p.m. and 10 p.m. when the hawks returned to their roosts (Pasanen and Sulkava, 1971). Occasionally rough-legs have been observed hunting between midnight and 3 a.m. in arctic Alaska (White, personal communication). Rough-legs wintering in Iowa were also diurnal, showing greatest activity during combinations of high wind velocities, clear skies, rising air pressure, low relative hlmidity, and high temperature, a set of conditions generally associated with fair weather (Schnell, 1967a). Craighead and Craighead (1956) reported that flight activity of several hawk species decreased during "bad weather."

clays and shales. Since the Gubic Formation erodes more rapidly than the underlying material, a sloping face results, ending in a point where the Gubic joins the nearly vertical face of the underlying shales. Such a point lies far enough below the brink of the cliff to afford some protection from terrestrial predators, making a highly desirable nesting site for the rough-leg (White and Cade, 1971). Rough-legs in the Canadian Northwest Territories nested on the steeper side of Precambrian outcroppings. Almost one-third of these nests occurred on the colder, but steeper north-facing cliffs, presumably as protection from terrestrial predators which could easily scale the more gentle south-facing slopes (Sealy, 1966).

Rough-legs have strong affinities for nesting sites, often returning to the same nest year after year, and occasionally nesting very closely to its own or to other species. Territorial behavior in these instances is usually not too pronounced (Brown and Amadon, 1968). Grasses and sticks of various sizes, piled together crosswise, form the nest. The amount of nesting material varies with location of the nest; a nest built on a flat rock may contain just enough material to keep the eggs from rolling out, while a nest located on a slope may contain much more material near the front in order to make the platform level. Older nests may be quite large, since the hawks add new material annually. Thick plant growth around an old nest results from accumulated droppings and food remains and may serve to locate a nest site which might otherwise go unnoticed. A deep, cup-like depression at the center of the nest, lined with moss, lichens and feathers, may protect the eggs and brooding adult from inclement spring weather. Nests average 61 - 76 cm across and 50 - 55 cm deep; nests in the southerly portions of the range average larger owing to a greater abundance of suitable nesting material (Bent, 1937; Brown and Amadon, 1968; Sutton and Parmelee, 1956).

Gyrfalcons (Falco rusticolus), peregrine falcons (Falco peregrinus tundrius), and ravens (Corvus corax principalis) utilize similar nesting habitat and may compete with rough-legs for nesting sites. The resident ravens and gyrfalcons begin breeding sooner and may usurp nests previously used by rough-legged hawks. Peregrines compete more directly by occasionally dislodging rough-legs from nests, even though both species arrive on the breeding grounds at about the same time. In one instance peregrines incubated two eggs in a nest which also contained two eggs of a rough-legged hawk. Presumably the rough-legs were driven from the nest by the peregrines after they had begun to lay eggs. The next year rough-legs attended the nest while a pair of peregrines nested about 90 meters away (White and Cade, 1971).

Although a common breeding species in many areas, the rough-leg's breeding densities fluctuate locally in response to food supplies (Pasanen and Sulkava, 1971; Brown and Amadon, 1968; White and Cade, 1971; White, personal communication). Along the Colville River bluffs, rough-legs utilized 70 to 90 percent of the available nesting habitat. Distances between pairs of rough-legged hawks averaged 3.8 kilometers, with a range of 0.4 kilometers to 32 kilometers (White and Cade, 1971). Nesting densities in the Northwest Territories averaged one pair of rough-legs per 13 to 26 square kilometers (Sealy, 1966). On a 200-square-kilometer area in Finland, rough-legs used 33 to 50 square kilometers per nest over a four-year period (Pasanen and Sulkava, 1971).

Beginning in late April, rough-legs lay clutches of three or four eggs, although in years when food is abundant clutch size may increase to five or six eggs. In northern areas egg-laying extends into June or July. The brief nesting season in northern latitudes almost invariably causes very late clutches to fail because the young do not have time to develop fully. For the same reason, rough-legs do not lay replacement clutches if they lose the first set of eggs. Egg markings vary widely; occasionally eggs are pure white, but they more often exhibit blotches and streaks of brown or reddish-brown. Eggs average 56.3 mm in length and 44.8 mm in diameter (Brown and Amadon, 1968).

After egg-laying, the male provides food, stands guard near the nest, and occasionally relieves the female of incubation duties. Eggs hatch in 28 to 31 days. Juvenile birds develop rapidly; daily weight gain can average 35 to 45 grams until the twentieth day, decreasing to between five and ten grams per day after the third week (Pasanen and Sulkava, 1971; Brown and Amadon, 1968). Within ten days of hatching the second down has replaced natal down, and by the thirty-fifth day feathers have grown in completely. By the age of fifteen days nestlings can swallow small animals whole, but they remain unable to dismember larger prey until about the twenty-fifth day. The female may assume an active role in food gathering during later nestling stages to help meet the increasing nutritional demands of the young birds. Young rough-legs take their first flight between the age of 36 and 40 days and leave the nest from early July to mid-August, at the age of six weeks (Pasanen and Sulkava, 1971; Brown and Amadon, 1968; Sutton and Parmelee, 1956).

The rough-legged hawk has few natural enemies. Terrestrial predators probably include foxes (Vulpes sp., Alopex sp.), but considering the accessibility of rough-legged hawk nests, the care with which adult birds guard the nest probably greatly minimizes predation upon the eggs and young (Bent, 1937). Springer (personal communication) once saw a pair of rough-legs

drive a fox from their nest site. White (personal communication) reports that wolves (Canis lupus) and golden eagles (Aquila chrysaetos) have been seen eating young rough-legs in nests in Alaska.

Rough-legged hawks vary seasonally in their response to man's approach. While nesting, adults display great excitement and concern, diving and screaming at the intruder, usually from a distance (Handley, 1956; Brown and Amadon, 1968; Sutton and Parmelee, 1956; Bent, 1937). But for several weeks after their arrival on the wintering grounds, rough-legs remain relatively unsuspicious of human presence, often allowing one to approach rather closely before taking flight (Bent, 1937; Brown and Amadon, 1968).

Since the rough-leg competes with several other avian species for common resources in the relatively simple arctic ecosystem, interspecific interactions are most common during the nesting season. Rough-legs, ravens, gyrfalcons, peregrine falcons and golden eagles all utilize similar nesting habitat in at least some portions of the Arctic. While breeding pairs usually minimize conflict by placing their nests out of view of one another, rough-legs occasionally nest so as to look directly into the nest of a breeding falcon. In such instances the falcons sometimes force the rough-legs to move their nest, especially if the distance involved is less than about 45 meters. Usually, however, nesting falcons and rough-legs share a cliff with little conflict. In one instance, peregrine falcons and rough-legged hawks nested within nine meters. Although the adult birds displayed terrific aggression throughout the nesting season, both pairs successfully reared young (White and Cade, 1971). Other observers have documented aggressive interactions between rough-legs and snowy owls (Nyctea scandiaca) (Sutton and Parmelee, 1956), rough-legs and prairie falcons (Falco mexicanus) (Bennett, 1938), and rough-legs and ravens (Springer, personal communication). The relationship between wintering rough-legs and red-tailed hawks (Buteo jamaicensis) will be treated later in this report.

Weather conditions and food supplies determine the onset of rough-leg migration. Large rodent populations in the arctic delay migration; normally, rough-legs begin to move south from the breeding grounds in late August or early September, spending November to March on the wintering grounds. Peak numbers of migrating rough-legs cross the northern United States about mid-October. Gregarious in migration, rough-legs congregate in groups of a few to many individuals. Mated pairs, even if they migrate in large flocks, often remain together throughout the winter (Brown and Amadon, 1968; Belknap, 1966; Beamer, 1946; Bent, 1937).

Wintering rough-legged hawks tend to concentrate in areas of high prey density, and some movement takes place in response to local fluctuations in prey abundance. Individual hawks may adopt winter territories of ten or more square kilometers. Where sufficient local rough-leg populations occur the birds roost communally and seem to prefer groves of conifers for roosting sites. While rough-legs also roost singly, communal roosting behavior does not result simply from a lack of suitable roosting sites, but appears to be part of the species' social behavior (Schnell, 1969; Weller, 1964; Brown and Amadon, 1968).

Much of the rough-leg's winter range overlaps that of the red-tailed hawk. Though both species show similarities in size and food habits, behavioral differences enable them to minimize competition in their winter environment. Rough-legged hawks hunt from flight, while red-tails are more sedentary, preferring to search for prey from an elevated perch. Rough-leg hunting habitat consists of open treeless areas; while red-tailed hawks may forage in these areas during migration, they prefer open woods and stream bottoms for hunting and roosting once they have settled into their winter habitat. Rough-legs move toward roadways to hunt after periods of snowfall, while red-tails generally react to increased snow cover or colder conditions by leaving the area. In selecting diurnal perches, rough-legs tend to prefer lone trees, perching relatively close to the ground, while red-tails prefer small groups and groves of trees, and perch at somewhat greater heights. Additionally, rough-legged hawks spend more time on the ground than do red-tails. These differences in habitat use resemble the habitat preferences of each species on its breeding grounds (Schnell, 1968; Weller, 1964).

Productivity in rough-legged hawks depends directly on cyclic populations of arctic rodents. It varies greatly from year to year but generally follows a fairly consistent four-year cycle over much of the species' range (Pasanen and Sulkava, 1971; Brown and Amadon, 1968; Lack, 1954; Schnell, 1967b; White, personal communication). Clutch size varies from two to six or seven eggs, averaging four or five in high rodent years; this number drops to two or three eggs when rodents are scarce (White, personal communication). Breeding success varies from one to seven young reared per nest. In normal rodent years a pair of adults usually rears two or three young, but when rodent populations crash, many young die before the age of two weeks (Brown and Amadon, 1968). Adult hawks may desert their eggs if rodent populations crash after the onset of incubation (White, personal communication). Sealy (1966) observed 2.8 young per nest in 1965 in the Canadian Northwest Territories, but did not note the number successfully fledged. The number of eggs per nest that year averaged 3.3. In Finland in 1963-66,

43 percent of observed eggs developed into flying young. Fifty percent of 152 eggs counted in a study area in Norway from 1938-46 developed into flying young (Pasanen and Sulkava, 1971).

Few rough-leg mortality factors have been determined. Sealy (1966) reported that predation upon young rough-legs appeared insignificant in the Canadian Northwest Territories. Certainly low food supplies during the brooding season trigger high juvenile mortality rates (Brown and Amadon, 1968). In Finland, rough-legs switched to birds when rodent populations collapsed, but still eventually ceased to bring food to the nest and the young died (Pasanen and Sulkava, 1971). Young hawks hatching from late clutches do not have time to develop sufficiently to withstand the rigors of migration (Brown and Amadon, 1968). Unseasonal spring storms may cause death by exposure to young rough-legs still in the nest (Pasanen and Sulkava, 1971).

Highway mortality may be great for wintering rough-legged hawks. Rough-legs suffer high winter road kills throughout Utah, mainly as a result of their feeding on road-killed jack rabbits (White, 1968).

Presst, Jeffries and MacDonald (1968) examined four dead rough-legs from Britain in 1967 and concluded that three of the four birds had probably died of dieldrin poisoning. The investigators believed that consumption of only a few animals that had fed on dieldrin-treated grain would have been sufficient to kill the hawks.

The rough-leg's gregarious migratory habits made it highly vulnerable to shooting, especially in the United States, before protective legislation was enacted. Pole traps and carrion poisoned in pest control activities probably accounted for additional mortality (Bent, 1937; Brown and Amadon, 1968).

5. Habitat Requirements and Limiting Factors

On breeding grounds in the American arctic, cliffs suitable for nesting form the most important component of rough-leg habitat and largely govern the species' distribution, at least in Alaska. In Alaska many nests occur on river bluffs, perhaps because of the rough-leg's preference for prey animals which frequent riparian and marshy habitat, but rough-legs also utilize isolated upland outcrops and other escarpments as well. The rough-leg exhibits considerable flexibility in its selection of a nest site and often builds its nest on what may be only the slope of a hill. In some portions of its range the rough-leg is essentially a ground-nesting bird. Where rough-legged hawks reach the southern limits of their breeding range, on the

fringe of the taiga, they frequently build nests in trees. But here, too, they utilize cliff-nesting habitat where it is available (Bent, 1937; White and Cade, 1971).

Preferred winter hunting habitat consists of open, marshy areas and wet meadows, reflecting the summer habitat preference of this species. While rough-legs utilize trees for gregarious roosting, their winter distribution is probably more a function of available food supply than of any other component of the habitat (Brown and Amadon, 1968; Weller, 1964; Schnell, 1968, 1969; Belknap, 1966).

Fluctuations in prey availability on the nesting grounds (see pages 5, 7, 11) probably serve more than any other single factor to limit rough-leg productivity. Several investigators have noted significant declines in productivity and nesting success when rodents became scarce (White and Cade, 1971; White, personal communication; Springer, personal communication; Swartz et al., 1975).

Pesticide contamination of rough-legged hawks appears unimportant at present, probably because the species feeds mainly upon non-migrant mammalian prey occupying relatively low trophic levels. Lincer et al. (1970) collected peregrine falcons, rough-legged hawks, their eggs and prey species from the Colville River, Alaska, in 1967 and analyzed them for DDE residues. On an oven-dry-weight basis, three peregrine eggs averaged 131 ppm p,p'-DDE while three rough-leg eggs averaged 7.07 ppm. Highest residue levels reached 752 ppm in peregrine fat tissues and 13.3 ppm in rough-leg fat tissues. Residues in migratory peregrine prey ranged from 0.15 ppm in muscle tissue to 4.55 ppm in fat tissue. For rough-leg prey items, the investigators conducted whole-carcass analysis of masked shrews (Sorex cinereus) and arctic shrews (S. arcticus), species which occupy a higher trophic level than the rough-leg's usual prey, microtine rodents, and thus probably represent maximum possible pesticide intake for rough-legs from small mammals. DDE levels in the shrews averaged 0.32 ppm, only about one-tenth to one-twentieth the amount of DDE found in the peregrine's migratory prey. These findings indicate that Alaskan rough-legged hawks are currently in no danger from pesticide poisoning (Lincer et al., 1970).

6. Protective Measures Instituted

1. The rough-legged hawk is included in the treaty signed by the United States and Mexico in 1972, bringing birds of prey under international protection.

2. The Alaska Department of Fish and Game requires that a permit be issued before any raptor may be removed from the wild.

7. Species and Habitat Management Recommendations

Rough-legged hawks currently enjoy relative freedom from the effects of pesticide contamination of their trophic system. Neither has man encroached heavily enough upon their breeding and wintering habitats to cause large-scale population declines. While the remoteness of the Alaskan arctic has long ensured the well-being of the organisms which live there, Alaska now faces vast developments of its mineral and energy resources, developments which might affect not only raptor populations but the arctic ecosystem as a whole. In dealing with man's increased activities in the North, first priority should be given to preserving critical wildlife habitats. But beyond singling out precarious species and habitats for protection, land and wildlife managers should concentrate on preserving natural communities in their entirety. To preserve rough-legged hawks we must first preserve, intact, the delicately balanced association of plants and animals of which rough-legs are a part, to assure not only rough-legs, but other arctic species as well, a place free from the effects of man's developments (J. McGowan, personal communication; A. Springer, personal communication).

8. Authorities

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9. Agencies and Organizations Actively Concerned With The Species' Welfare

State of Alaska
Department of Fish and Game
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Fairbanks, Alaska 99701

The Alaska Department of Fish and Game is currently preparing wildlife management plans which will include raptors. While the raptor plan will probably not deal directly with rough-legged hawks, it will consider cliff-nesting raptors as a group, giving inherent protection to rough-legs. The Department is also working to designate critical habitat areas for gyrfalcons and peregrines, which will also protect rough-legs indirectly. Until the management plans and critical habitat areas have been adopted in final form, potential conflicts are being identified by field observation and review of impact statements. Stipulations to protect raptors are prescribed based on the specific situation. This approach has been effective in several instances along the pipeline route and in connection with oil exploration activities along the Colville River. The Department's objective is to protect the habitat of all raptors, not just that of endangered species (Jerry McGowan, game biologist, personal communication).

10. Summary

The rough-legged hawk is the most common hawk of the American arctic. Females, larger than males, average about 1200 grams in weight. Males weigh about 900 grams. Plumage color varies greatly, ranging from a nearly uniform dark plumage to light brown with only scattered darker markings on a nearly white ventral surface, with wide whitish edges on individual dorsal feathers. Owing to this plumage variation rough-legs may be difficult to identify in the field. Helpful field characteristics include: dark patches at the carpal joints on ventral wing surfaces, white on the rump and base of the tail except in very dark birds, a broad dark abdominal band in many plumages, and fully feathered tarsi.

Buteo lagopus sanctijohannis breeds from the extreme eastern end of the Aleutian Islands, southwest coastal and arctic Alaska across northern Canada to northern Labrador, Newfoundland, and southeast Quebec. This subspecies winters across southern Canada and the United States south to California, Arizona, New Mexico, Oklahoma and Missouri.

Microtine rodents and other small mammals comprise the bulk of the rough-leg's diet. During the breeding season in some areas, birds may form up to 20 percent of the food items consumed, but in winter months rough-legs utilize mammalian prey almost exclusively.

Rough-legs usually hunt from flight over wet meadows, bogs and riparian habitats. Wintering hawks avoid hunting over plowed fields. Finnish rough-legged hawks utilized hunting territories of three to five square kilometers during incubation and five to eight square kilometers after the young had hatched. Winter hunting territories averaged 10.5 to 15.5 square kilometers in area.

Rough-legs engage in relatively short and simple courtship activities upon arrival at the nesting grounds from mid-March to late April. While they utilize trees for nesting in southern portions of their range, rough-legged hawks are essentially cliff-nesting birds, nesting along river bluffs and on outcroppings where they are available.

Ravens, peregrine falcons, and gyrfalcons, also cliff-nesting birds, may compete with rough-legs for nesting sites. Ravens and gyrfalcons begin nesting sooner and sometimes usurp rough-leg nests, while peregrines occasionally actively dislodge nesting rough-legs and take over the nest site.

Nesting density fluctuates locally according to the food supply. Along bluffs of the Colville River, Alaska, distance between nests averaged 3.8 km, ranging from 0.4 to 32 km. In the Northwest Territory, nesting densities ranged from 13 to 26 square kilometers per rough-leg nest.

An average rough-leg clutch consists of three or four eggs. Clutch size increases during times of abundant food, and decreases when rodents become scarce. Because of the short arctic summer, rough-legs lay no replacement clutches, and young from late clutches have insufficient time to develop fully before they must migrate.

The male provides food for the female and occasionally takes her place over the incubating eggs, which hatch in 28 to 31 days. Juvenile birds develop rapidly and leave the nest at the age of six weeks.

Aggressive interactions with other species are few and center mainly around nesting activities. Rough-legs usually tolerate the proximity of other nesting raptors and rear their young with few problems.

Weather and food supply regulate the onset of migration. Under normal conditions rough-legs begin to move south in late August or early September, with peak numbers crossing the northern United States in mid-October. They congregate during migration, sometimes in large groups. Mated pairs often remain together throughout the winter.

Rough-legged hawks tend to concentrate in wintering areas having high rodent densities, and movement occurs in response to local fluctuations in prey abundance. Winter territories average about 10 square kilometers in area. Communal roosting, often in groves of conifers, is common and appears to be part of the species' social behavior. Winter habitat selection tends to reflect the habitat preferences of the species on its breeding grounds.

Spring migration begins in late March or early April, with snowmelt conditions determining the rate of northward movement. The birds arrive at breeding areas in late April or early May. Young rough-legs probably return to the area on which they were reared.

Productivity follows a fairly consistent four-year cycle in response to prey abundance. In high rodent years clutches average four or five eggs; this drops to only one or two eggs when rodents are scarce. Breeding success ranges from one to seven young reared per nest, averaging two or three in normal years. Adult birds may abandon their eggs if rodent populations crash during the incubation period.

Mortality factors appear to be few. Predation, starvation and unseasonal spring storms take their toll of young birds. Before protective laws were passed, shooting was a significant cause of mortality, especially in the United States. Carrion poisoned for pest control probably kills some birds. Wintering rough-legs suffer significant mortality as a result of road kills in some areas. Direct poisoning by dieldrin where grain has been treated with this substance and consumed by rodents has also caused some rough-leg mortality.

Cliff-nesting situations form the prime component of rough-leg breeding habitat and largely governs the species' distribution, at least in Alaska. Even where rough-legs nest in trees in southern portions of their range, they utilize cliff-nesting habitat where it is available. Food availability probably determines winter distribution more than any other single habitat component.

The greatest threat to the rough-legged hawk lies in the development of mineral and energy reserves in the arctic. Habitat managers should give first priority to preserving

critical wildlife habitat areas. But rough-legs and other arctic species can best survive only as part of a natural and undisturbed arctic ecosystem. Only by providing adequate and undisturbed wildlife habitat can we assure that the rough-leg, and other arctic species as well, will not succumb to the effects of man's developments.

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